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21/72 21/76 21/78

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(54) Abstract Title
Switch

(57) A switch for detecting the position of an automatic gear shifter of an automobile comprises an axle 21 rotatable within a bearing hole 11 of a case 1, a movable plate 2 integral with the axle 21 so as to be movable in the case 1, a movable contact 22 supported on the movable plate 2, a fixed contact 31 supported on a base 3 which houses the movable plate 2 in conjunction with the case 1 and an operating lever 4 which is fixed to the axle 21 and which is movable on an external surface 12 of the case 1. The axle has an end portion 711 having projecting teeth 713,714 which fit into slots 951,952 located around a hole 95 in the operating lever in which the end portion 711 fits. The axle and the operating lever are ultrasonically bonded at the end portion 711.

FIG. 2

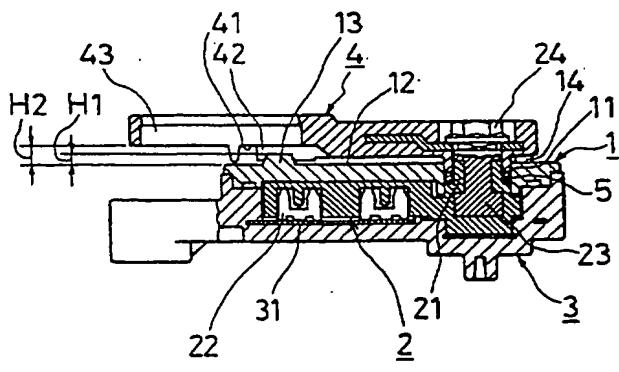
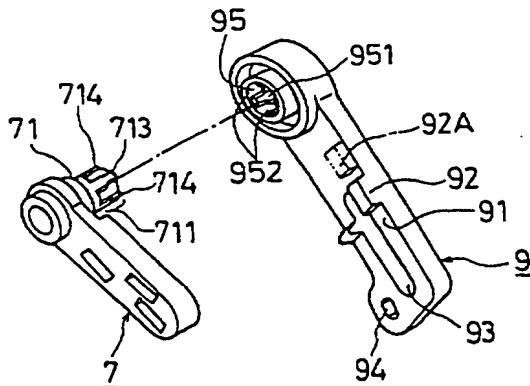


FIG. 6



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FIG. 1

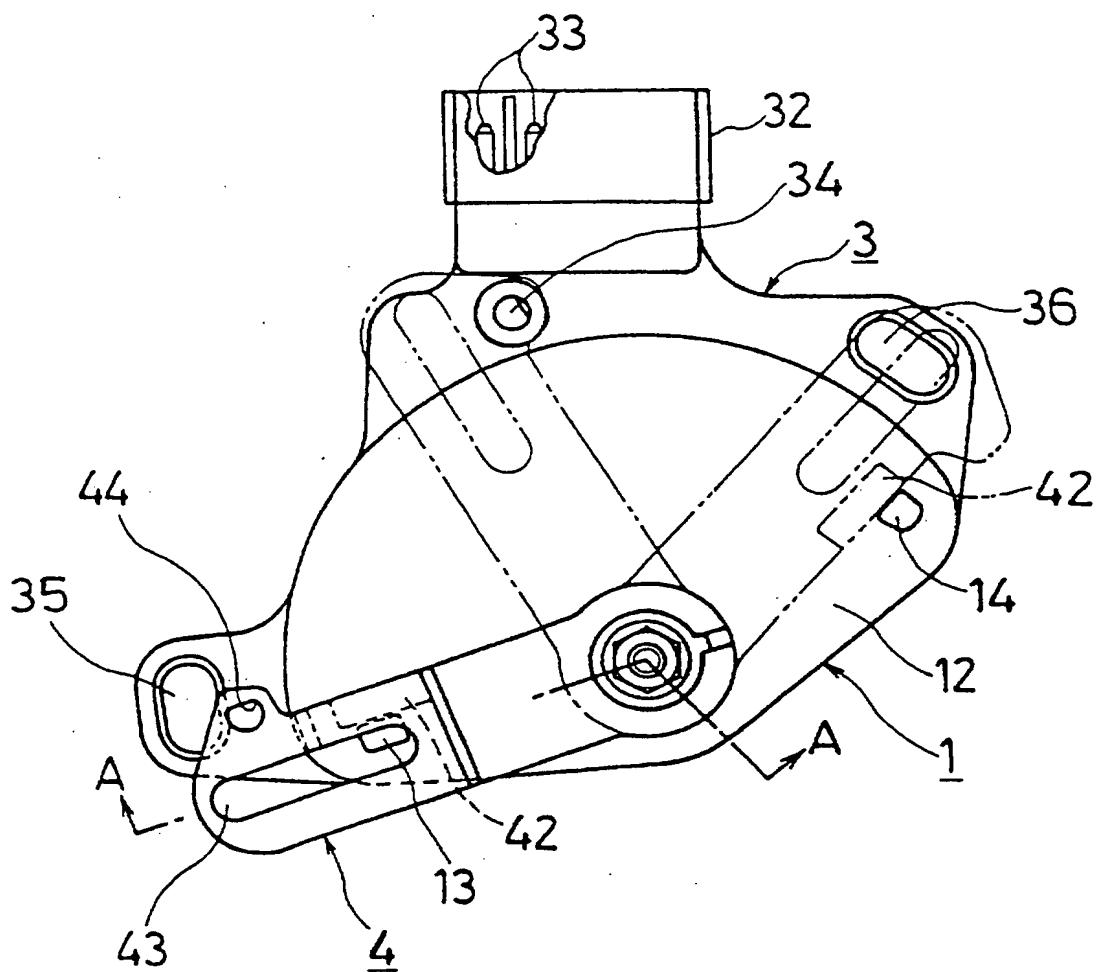


FIG. 2

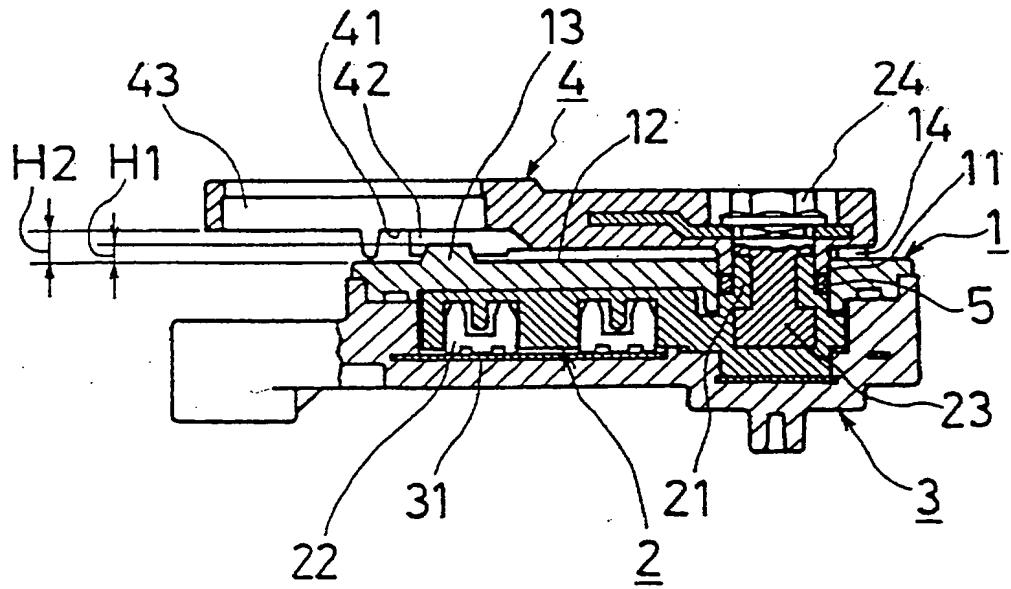


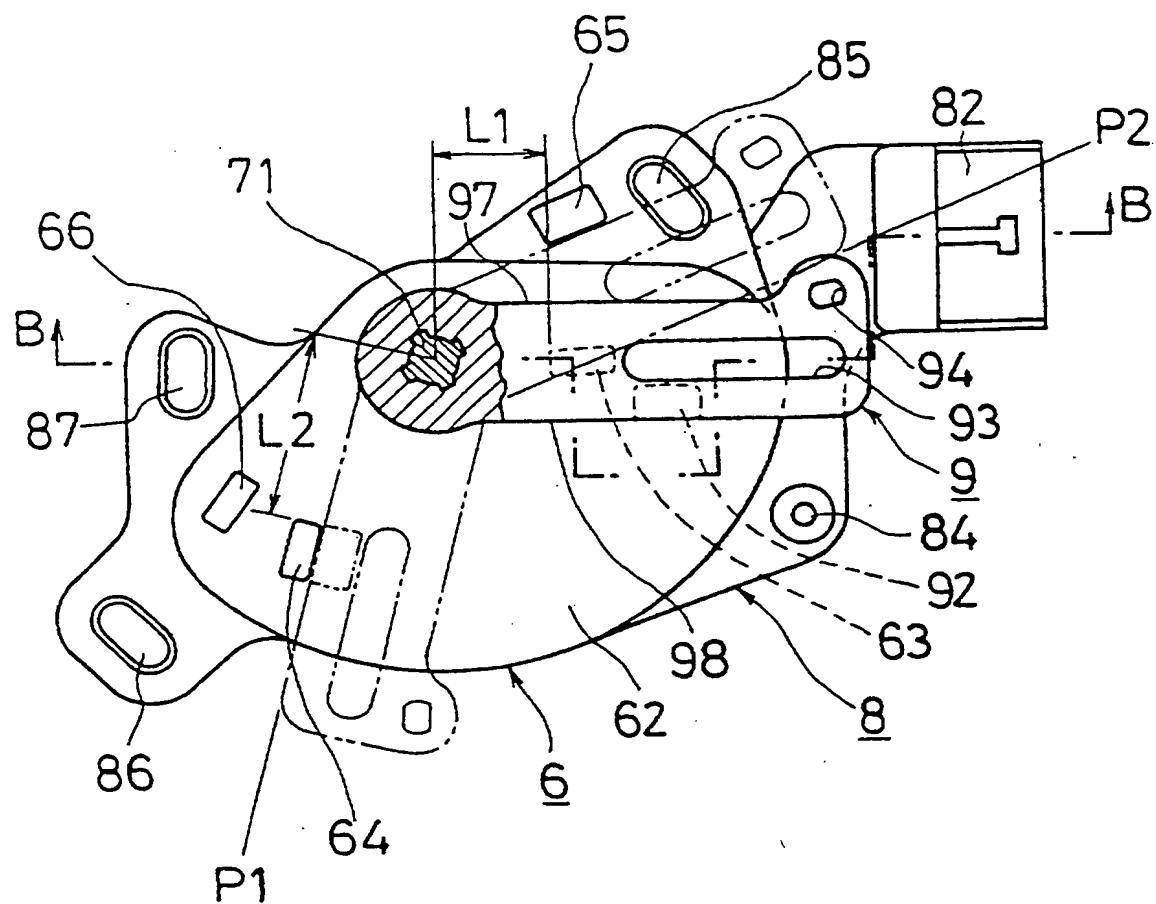
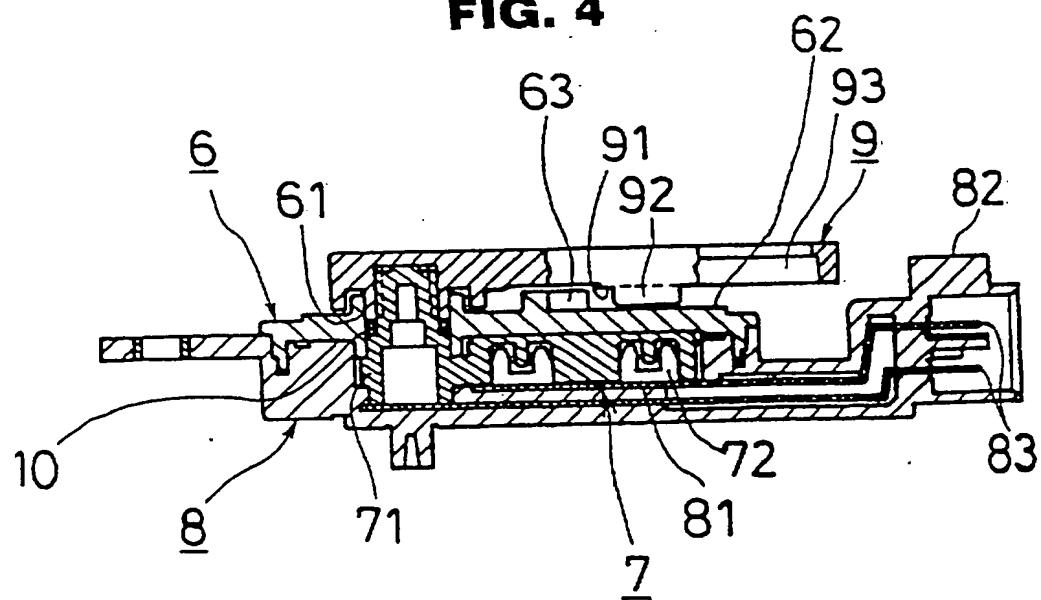
FIG. 3**FIG. 4**

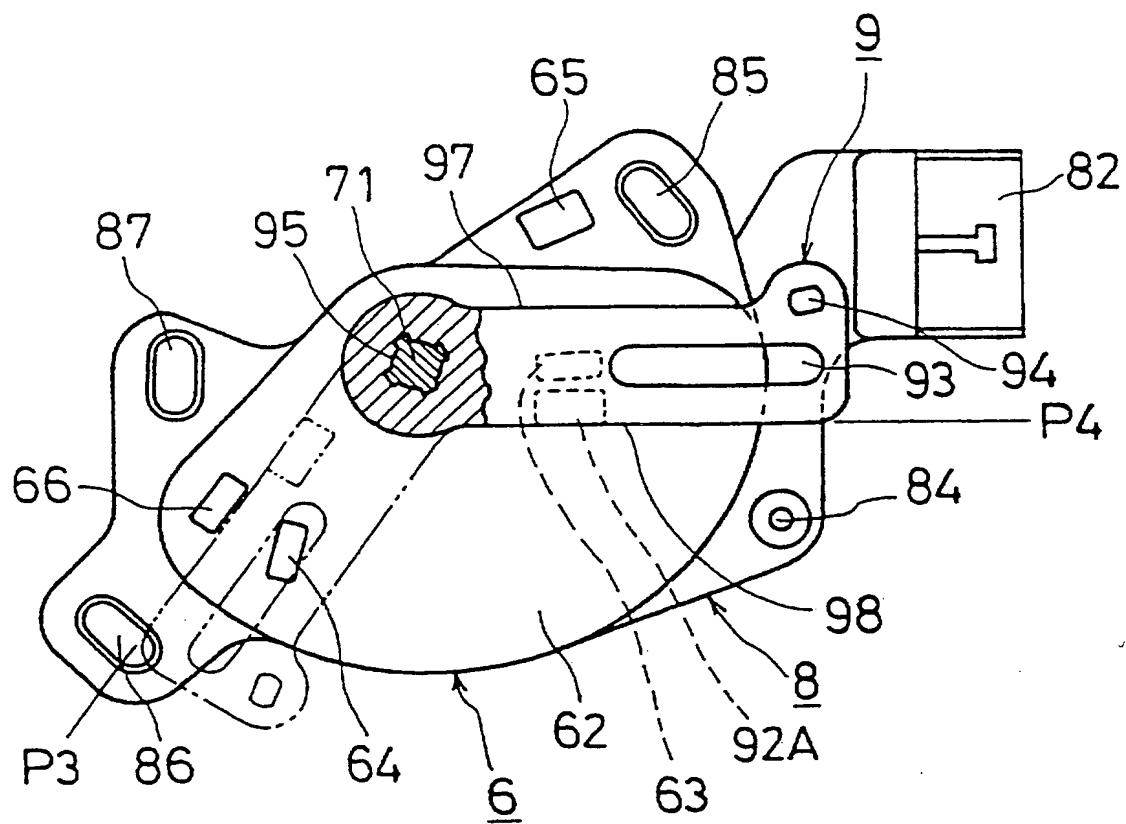
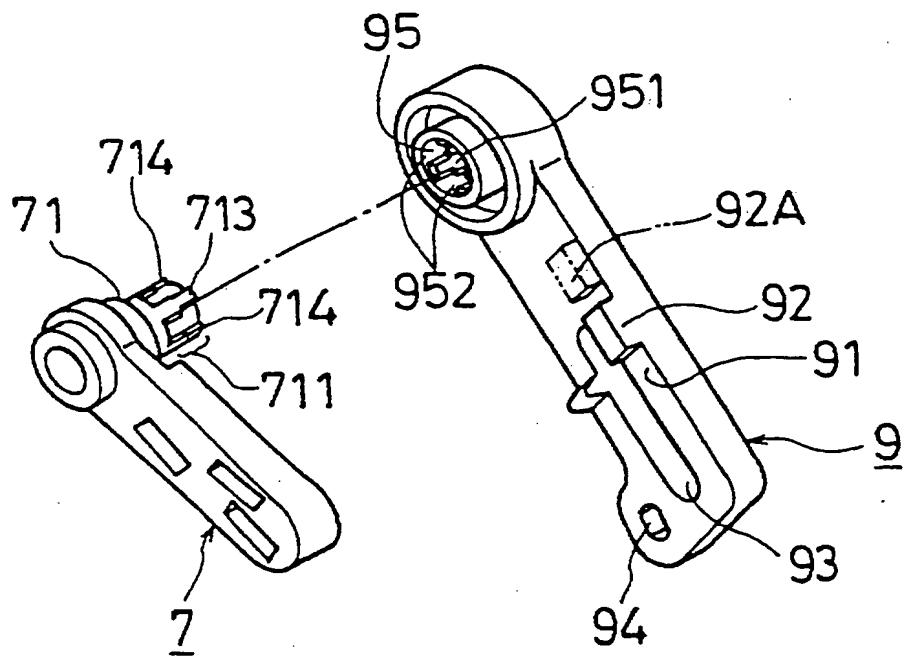
FIG. 5**FIG. 6**

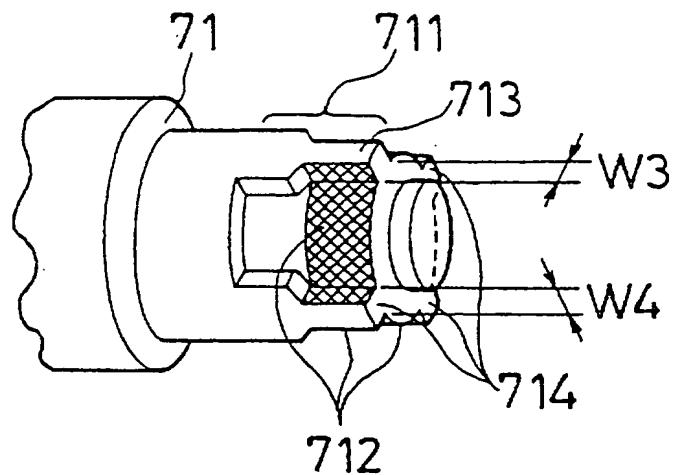
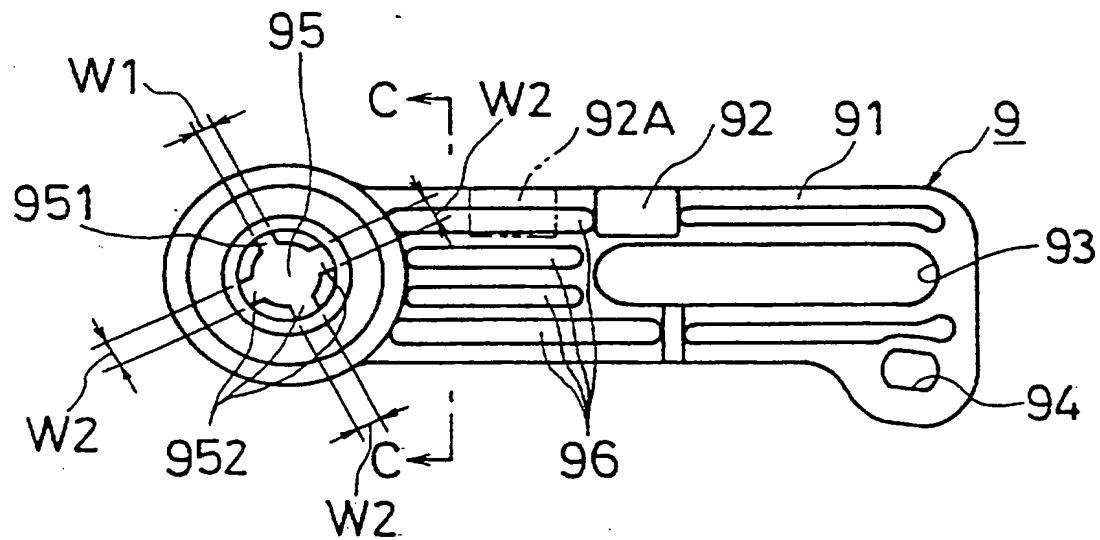
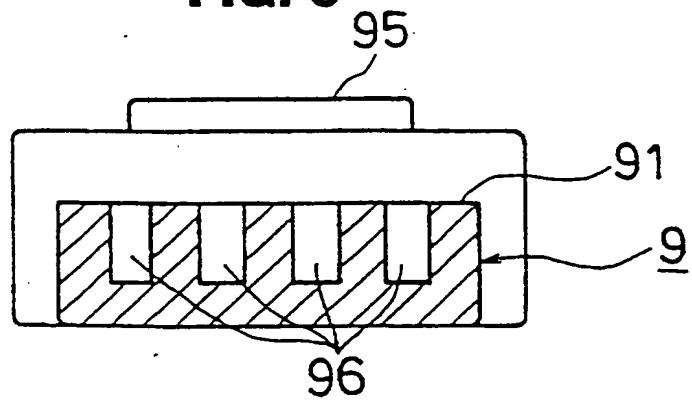
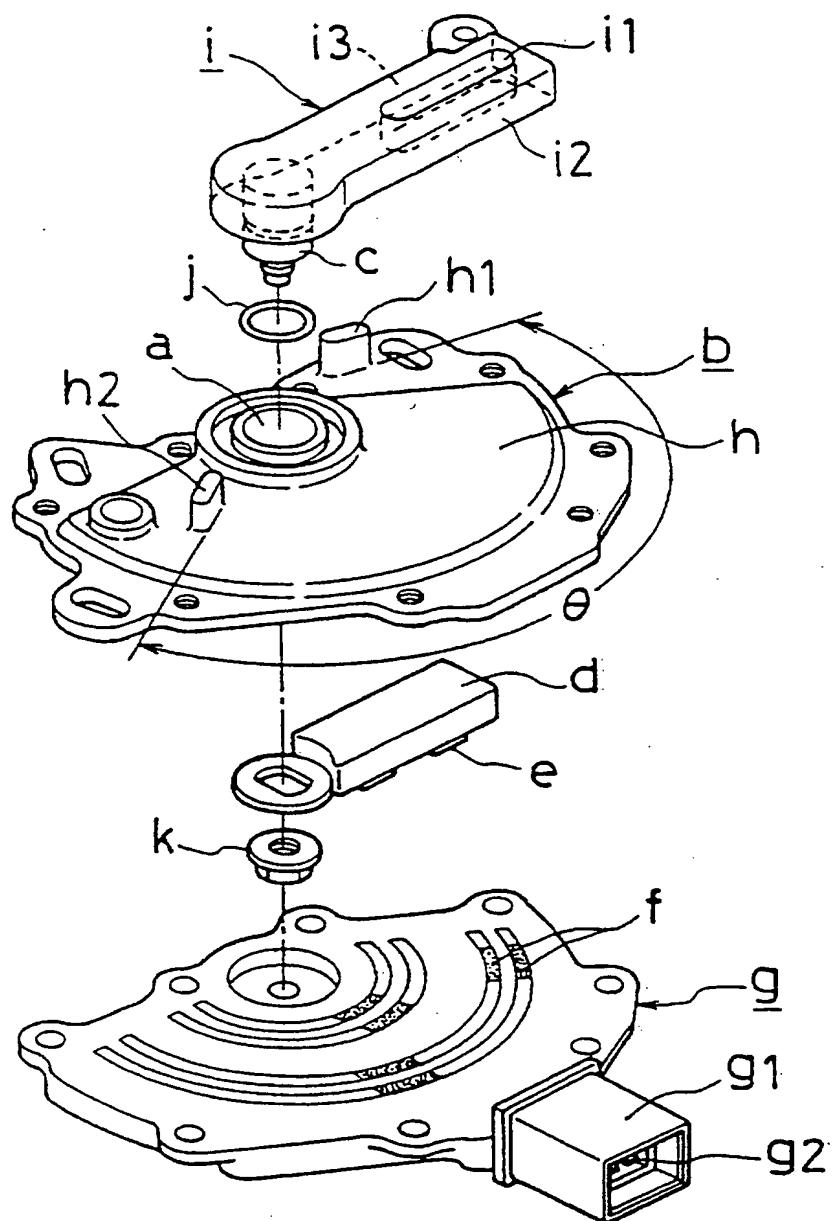
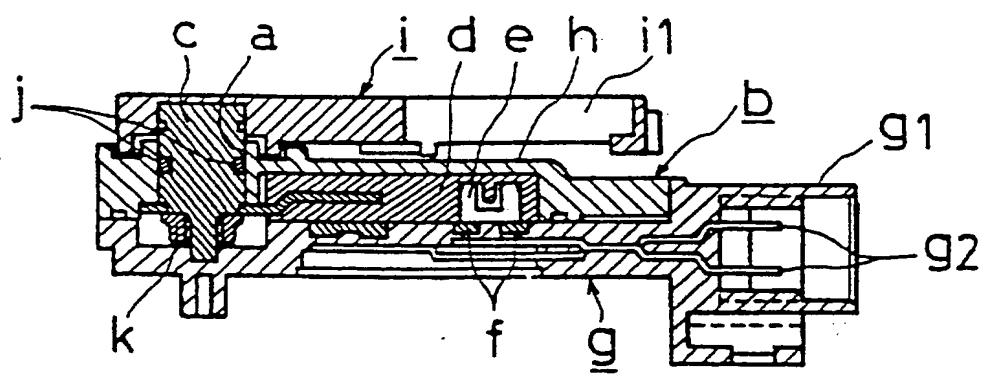
FIG. 7**FIG. 8****FIG. 9**

FIG. 10**FIG. 11**

INHIBITOR SWITCH DEVICE

The present invention relates generally to an inhibitor switch that detects the position of an automatic gear shifter of an automobile and, in particular, to an inhibitor switch device having an improved rotating torque bearing and an improved stopper arrangement for limiting a range of movement of an operating lever.

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An inhibitor switch device related to the present invention has been used as a switch to detect the position of an automatic gear shifter of an automobile. Such an inhibitor switch device is disclosed, for example, in Japanese Laid Open Patent Publication No. Hei 2(1990)-145736.

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Figs. 10 and 11 illustrate an example of a conventional inhibitor switch device. The conventional inhibitor switch device includes a case b that has a bearing hole a, a rotating axle c that fits into the bearing hole a so that the rotating axle c moves freely, a movable plate d that is integrated with the rotating axle c and moves freely in the case b, a movable contact point e on the movable plate d, a fixed contact point f that corresponds with the movable contact point e, a platform g that supports the fixed contact point f and houses the movable plate d by connecting with the case b, and an operating lever i that is fixed to the rotating axle c and, at the same time, moves freely on an external

5 axle c and, at the same time, moves freely on an external surface h of the case b. Two stoppers h1 and h2 are provided on the external surface h of the case b. Each edge i2 and i3 of the operating lever i impacts one of the stoppers h1 and h2, so that the range of movement θ of the operating lever i is limited.

10 The rotating axle c is comprised of metal materials and is formed by insertion molding into the operating lever i. An O-ring j is installed on the rotating axle c and seals the gap between the rotating axle c and the case b. Furthermore, the rotating axle c is fixed to the movable plate d using a nut k. A connector g1 is integrated into the platform g, and a terminal g2 is electrically connected with the fixed contact point f 15 inside the connector g1.

20 In an inhibitor switch device that has the above-described structure, a connecting hole i1 of the operating lever i is connected to the manual valve of an automatic gear shifter (not shown) or a shift lever by the driver's seat (not shown) of a vehicle, for example, so that when the operating lever i moves along with the movement of the shift lever, the movable plate d within the case b moves along with the operating lever i, and the movable contact point e moves in and out of 25 connecting positions with the fixed point f. The fixed point f is connected to a controller (not shown) via a terminal g2, so that the controller can control each action by on/off signals that correspond to the shifter position.

30 The conventional inhibitor switch device described above has a structure wherein both edges i2, i3 of the operating lever i impact each stopper h1 and h2 so that the range of movement of the operating lever i is limited. Therefore, since the stoppers h1 and h2 are

formed on the case b, the range of movement θ of the operating lever i cannot extend outside of the case b. If the range of movement θ of the operating lever i is to be enlarged or extended in either direction past the edge 5 of the case b, it is necessary to increase the size of the case b or add a projected portion to the case to position the stoppers h1 and h2 at appropriate locations.

Moreover, in the case that the rotating axle c of the conventional inhibitor switch device is bonded to the 10 operating lever i by ultrasonic bonding, when the material of the rotating axle c is changed from a metal to a resin material, there is a risk that the bonded portion is destroyed due to the rotating torque that the operating lever i receives, unless the strength of the 15 ultrasonic bonding is enhanced. In addition, when the shape of the rotating torque bearing is chosen to be a simple toothed wheel in order to enhance the strength of the ultrasonic bonding portion, the relative position between the movable plate d and the operating lever i 20 during assembly is such that it is possible to be assembled incorrectly. If the relative position between the movable plate d and the operating lever i during assembly is improper, a problem exists because the 25 position of the shifter will not be properly detected by the inhibitor switch device.

An object of the present invention is to solve the problems with the conventional inhibitor switch devices 30 described above.

More specifically, it is an object of the present invention to provide an inhibitor switch device having stoppers on the external wall of the case that provide a limited range of movement of the operating lever that

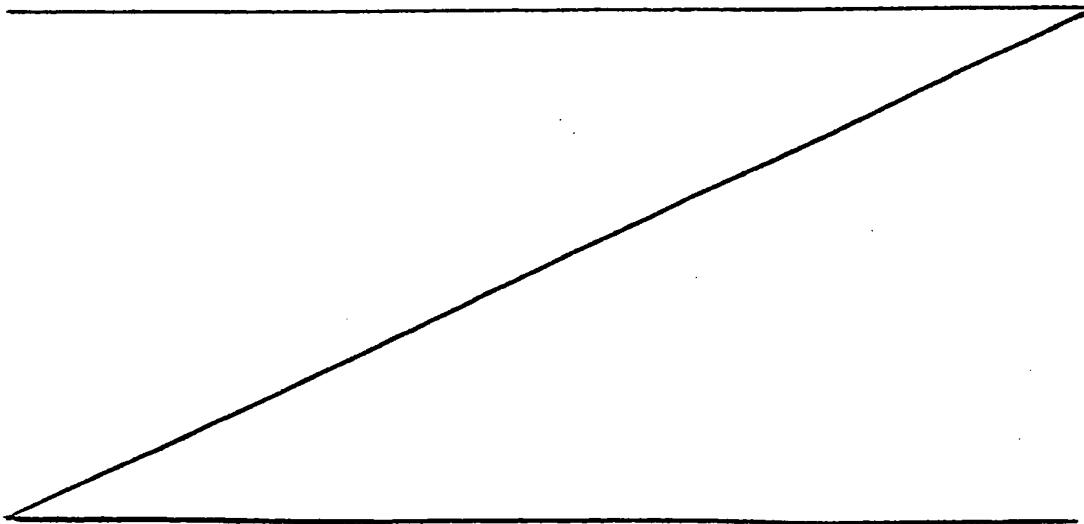
extends outside of the case.

It is a further object of the present invention to provide a switch inhibitor device having multiple sets of stoppers on the external wall of the case which are 5 adapted to provide different ranges of movement for different operating levers.

It is a further object of the present invention to provide a switch inhibitor device having a rotating axle made of resin, the rotating axle being bonded to the 10 operating lever with ultrasonic bonding, wherein the strength of the ultrasonic bonding portion is enhanced so that it prevents breaking of the bonded part.

It is yet a further object of the present invention to provide a switch inhibitor device in which the 15 relative position between the movable plate and the operating lever during assembly is standardized so that it prevents improper assembly.

Additional objects, advantages and novel features of the invention will be set forth in part in the 20 description that follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the 25 instrumentalities and combinations particularly pointed out in the appended claims.



In accordance with a first aspect of the present invention, in order to solve the problems described above, an inhibitor switch device is provided, comprising: a case with a bearing hole; a rotating axle that fits into the bearing hole so that the rotating axle rotates freely; a movable plate that moves freely in the case, the movable plate being integrated with the rotating axle; a movable contact point supported on the movable plate; a fixed contact point that corresponds with the movable contact point; a platform that supports the fixed contact point and houses the movable plate in conjunction with the case; an operating lever that is fixed to the rotating axle and moves on an external surface of the case; and a rotating torque bearing having projected portions in a toothed-wheel shape formed on the

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rotating axle, the operating lever having slots and a bonding hole into which the rotating torque bearing fits, and the rotating axle and the operating lever are bonded together by ultrasonic bonding at the torque bearing.

5 A width W1 of one of the slots is preferably set to be narrower than a width W2 of another one of the slots, and a width W3 of one of the projected portions of the corresponding rotating torque bearing is preferably set to be narrower than a width W4 of another one of the 10 projected portions. The widths W1, W2, W3 and W4 are preferably set according to the relationship $W3 \leq W1 < W4 \leq W2$.

15 The present invention will become more clearly appreciated as the disclosure of the invention is made with reference to the accompanying drawings. In the drawings:

20 Fig. 1 is a plan view of an inhibitor switch device.

Fig. 2 is a cross-sectional side view of the inhibitor switch device as viewed along the line A-A in Fig. 1.

25 Fig. 3 is a plan view in partial section of an inhibitor switch device according to an embodiment of the present invention.

30 Fig. 4 is a cross-sectional side view of the inhibitor switch device according to the embodiment of the present invention as viewed along the line B-B in Fig. 3.

Fig. 5 is a plan view in partial section of the inhibitor switch device shown in Fig. 3 with the location of the operating lever changed.

Fig. 6 is a perspective view of the movable plate and operating lever used in the inhibitor switch device shown in Figs. 3 to 5.

5 Fig. 7 is an enlarged perspective view of a rotating torque bearing of the movable plate shown in Fig. 6.

Fig. 8 is an enlarged plan view of the operating lever shown in Fig. 3 as viewed from below.

Fig. 9 is a cross-sectional view of the operating lever as viewed along the line C-C in Fig. 8.

10 Fig. 10 is an exploded perspective view of a conventional inhibitor switch device.

Fig. 11 is a cross-sectional side view of the conventional inhibitor switch device shown in Fig. 10.

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An inhibitor switch device will now be described in detail with reference to Figs. 1 and 2 of the drawings.

20 A case 1 is made from a synthetic resin and has a bearing hole 11 that fits a rotating axle 21 (described below) so that the rotating axle 21 rotates freely. A movable plate 2 is made out of a synthetic resin, such as, for example, polyphenylene sulfide (PPS). The movable plate 2 is integral with the rotating axle 21 and has a movable contact point 22 on a bottom portion thereof. A metal shaft 23 is formed by insertion molding within the rotating axle 21. An operating lever 4 is fixed to the rotating axle 21 by tightly threading a nut 24 onto the shaft 23, so that the operating lever 4 and the movable plate 2 interlock and move with the rotating axle 21 on an axis. The operating lever 4 can move freely on an external surface 12 of the case 1, and the movable plate 2 can move freely within the case 1.

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A platform 3 supports a fixed contact point 31, which corresponds with the movable contact point 22. The fixed contact point 31 is insertion molded into the platform 3 and is electrically connected with a terminal 33. A connector 32 is integrated with the platform for connecting the inhibitor switch device to an external wire harness or the like (not shown). The platform 3 is connected with the case 1 by ultrasonic bonding or the like, which forms a sealed space between the platform 3 and the case 1. The movable plate 2 is housed within the sealed space. A gap between the rotating axle 21 and the bearing hole 11 is sealed with an O-ring 5 that is mounted on the rotating axle 21.

The operating lever 4 has a slit 43, which is connected to a manual valve (not shown) of an automatic gear shifter or shift lever (not shown) by a driver's seat so that the operating lever 4 moves when the shift lever is operated. The operating lever 4 has a projected portion 42 on its bottom side 41. Also, the case 1 has stoppers 13 and 14 on an external wall 12. The projected portion 42 impacts the stoppers 13 and 14. A height H1 of the stoppers 13 and 14 from the external wall 12 is set lower than a height H2, which is the height of the bottom side 41 of the operating lever 4 from the external wall 12. Therefore, only the projected portion 42 of the operating lever 4 impacts with the stoppers 13 and 14 of the case 1.

In addition, the operating lever 4 has a positioning portion 44. The positioning portion 44 is used for mounting the inhibitor switch device onto an automatic gear case (not shown) in an appropriate position. The platform 3 has a positioning hole 34 that corresponds with the positioning portion 44. When the inhibitor switch device is mounted on an automatic gear case, a pin

(not shown) is pushed through both the positioning portion 44 of the operating lever 4 and the positioning hole 34 of the platform 3 to determine a proper position of the operating lever 4. Then, bolts (not shown) are put through slots 35 and 36 of the platform 3 and fastened to the automatic gear case.

5 An operation of the inhibitor switch device will now be explained.

10 First, when the driver in the vehicle operates the shift lever, its operation power is transmitted to the automatic gear shifter via an arm on the lower portion of the shift lever to a control cable, which interconnects with the operating lever 4. The operating lever 4 is thereby driven and moves over the external wall 12 of the case 1. When the operating lever 4 moves, the movable 15 plate 2 moves inside the case 1, and the connecting position of the movable contact point 22 and the fixed contact point 31 is switched. Then, the fixed contact point 31 inputs an on/off signal, which corresponds to the shift position, to a controller (not shown) via the terminal 33. Then, the controller conducts a control 20 according to the input signal.

25 An embodiment of an inhibitor switch device according to the present invention will now be described in detail with reference to Figs. 3 to 9 of the drawings.

30 A case 6 is made from synthetic resin and has a bearing hole 61 that fits a rotating axle 71 (described below) so that the rotating axle 71 rotates freely. A movable plate 7 is made from synthetic resin, such as, for example, PPS resin. The movable plate 7 is integral with the rotating axle 71 and has a movable contact point 72 on a bottom portion thereof. An operating lever 9 is bonded by ultrasonic bonding to the rotating axle 71, so that the operating lever 9 and the movable plate 7 move

together with the rotating axle 71 as the axis of rotation. The operating lever 9 moves freely on an external surface 62 of the case 6, and the movable plate 7 is freely movable inside the case 6.

5 As shown in Figs. 6 and 7, the movable plate 7 has a rotating torque bearing 711. The rotating torque bearing 711 has a projecting portion 713 and projecting portions 714, which are organized with interlocking teeth on the rotating axle 71. As shown in Figs. 6 and 8, the
10 operating lever 9 has gutters 951 and 952 and a bonding hole 95 into which the rotating torque bearing 711 fits. In order to ultrasonically bond the rotating axle 71 and the operating lever 9, the rotating axle 71 is initially inserted into the bearing hole 61 from the inside of the
15 case 6. Then, the gutters 951 and 952 and the bonding hole 95 of the operating lever 9 are fitted over the rotating torque bearing 711, which is projected from the external wall 62 side of the case 6. Then, ultrasonic waves are added from the operating lever 9 side with an
20 ultrasonic bonding head (not shown). Then, a bonding spot 712 of the rotating torque bearing 711 is bonded to the gutters 951 and 951 and the bonding hole 95 of the operating lever 9.

25 As shown in Figs. 6 and 7, each of the projected portions 713, 714 comprises a first narrow projected portion and a second wider projected portion, and each of the slots 951, 952 comprises a first narrow slot portion and a second wider slot portion. The narrow projected portions are received in the narrow slot portions when
30 the operating lever 9 is attached to the rotating torque bearing 711, and the wider projected portions are received in the wider slot portions. The bonding spot 712 is located between the narrow projected portions.

As shown in Fig. 8, a width W1 of one of the gutters

951 on the operating lever 9 is set narrower than a width W2 of the other gutters 952 on the operating lever 9. Similarly, on the rotating axle 71, a width W3 of one of the projecting portions 713 of the rotating torque bearing 711 is set narrower than a width W4 of the other projecting portions 714, as shown in Fig. 7. The relationship of the widths W1, W2, W3, and W4 can be expressed as $W3 \leq W1 < W4 \leq W2$. By setting the widths in this manner, the relative positioning between the movable plate 7 and the operating lever 9 during assembly can be standardized to prevent improper assembly.

5 A platform 8 supports a fixed contact point 81, which corresponds with the movable contact point 72. The fixed contact point 81 is insertion molded into the platform 8 and is electrically connected with a terminal 83. A connector 82 is integrated with the platform 8 for connecting the inhibitor switch device to an external wire harness or the like (not shown). The platform 8 is connected with the case 6 by ultrasonic bonding or the like, which forms a sealed space between the platform 8 and the case 6. The movable plate 7 is housed within the sealed space. A gap between the rotating axle 71 and the bearing hole 61 is sealed with an O-ring 10 that is mounted on the rotating axle 71.

10 20 25 30 The operating lever 9 has a coupling slot 93, which is a slot-shaped hole. The coupling slot 93 is coupled to the manual valve of an automatic gear shifter or the shift lever between the car seats so that the operating lever 9 moves when the shift lever is operated. The operating lever 9 has a projecting portion 92 on a bottom side 91 thereof. The case 6 has stoppers 64 and 65 protruding from an external wall 62 thereof. A height of the stopper 64 from the external wall 62 is set smaller than a height of the bottom side 91 of the operating

lever 9 from the external wall 62. In addition, a height of the stopper 65 from the external wall 62 is set larger than a height of the bottom side 91 of the operating lever 9 from the external wall 62. Therefore, the 5 projecting portion 92 impacts the stopper 64 at a moving position P1 shown in Fig. 3. In addition, the side 97 of the operating lever 9 impacts the stopper 65 at a moving position P2.

The case 6 contains stoppers 63 and 66 in addition 10 to the stoppers 64 and 65. The stoppers 63 and 66 function to change the moving position of the operating lever 9 from the moving positions P1 and P2 shown in Fig. 3 to the moving positions P3 and P4 shown in Fig. 5 by changing the location of the projecting portion 92A on 15 the operating lever 9 without changing the case 6.

Specifically, the operating lever 9 can be replaced or altered so that it has a projected portion 92A at the position shown with dotted lines in Fig. 5 and dashed lines in Figs. 6 and 8, instead of a projected portion 92 at the position shown in Fig. 3. The height of the stopper 63 from the external wall 62 is set lower than the height from the external wall 62 to the bottom side 91 of the operating lever 9. The height of the stopper 66 from the external wall 62 is set higher than the 20 height from the external wall 62 to bottom side 91 of the operating lever 9. In addition, the distance L1 from the center of the rotating axle 71 to the stopper 63 is set shorter than the distance L2 from the center of the rotating axle 71 to the stopper 64. The stopper 63 is 25 positioned in alignment with the path of movement of the projecting portion 92A on the operating lever 9A. Therefore, the projecting portion 92A impacts the stopper 63 at the moving position P4, as shown in solid lines in 30 Fig. 5, and the other side 98 of the operating lever 9

impacts the stopper 66 at the moving position P3, as shown in dashed lines in Fig. 5.

The operating lever 9 has a strength adjusting portion 96, as shown in Figs. 8 and 9. The strength adjusting portion 96 is a portion to adjust the strength of the operating lever 9 so as to control the location of any breakage that might occur in the operating lever 9. The strength adjusting portion 96 is set at an appropriate strength so that the operating lever 9 will not be broken by a regular external force during normal operation of the operating lever 9. However, when an unexpected external force is applied, the operating lever 9 is designed to break at the strength adjusting portion 96, instead of at the rotating axle 71. For example, if the operating lever 9 accepts an external force in an up and down direction while driving the vehicle in addition to the normal rotating force, or if the operating lever 9 is stressed while installing the inhibitor switch device, the strength adjusting portion 96 will break without causing damage to the rotating axle 71.

The strength adjusting portion 96 comprises a plurality of grooves extending in a longitudinal direction on a lower side of the operating lever 9. The grooves extend from an end point of the operating lever 9 adjacent the rotating axle 71 to an intermediate point of the operating lever 9 spaced from the rotating axle 71. The strength of the strength adjusting portion 96 can be adjusted by changing the size of the width of the grooves during the process of molding the operating lever 9 in a metal mold. Moreover, a plurality of metal molds having different groove widths can be used to provide operating levers 9 having different strengths. The operating levers 9 having different strengths based on the groove width of the strength adjusting portion 96 can be used to

provide an operating lever 9 having the precise strength necessary and suitable for each switch application.

In addition, the operating lever 9 has a positioning portion 94. The positioning portion 94 is for mounting the inhibitor switch device onto an automatic gear case (not shown) in the appropriate position. The platform 8 has a positioning hole 84 that matches with the positioning portion 94. When the inhibitor switch device is mounted on an automatic gear case, a pin (not shown) is pushed through both the positioning portion 94 of the operating lever 9 and the positioning hole 84 of the platform 8. Then, bolts (not shown) are inserted into the slots 85 and 86 of the platform 8 to fasten the platform 8 onto the automatic gear case. The operation of the second embodiment is generally the same as the first embodiment described above and, therefore, a further explanation will be omitted.

As described above, the present invention provides an inhibitor switch device that has projected portions on the bottom side of the operating lever and stoppers where the projected portions impact the external wall of the case. With this arrangement, even in the event that the movement range of the operating lever goes outside of the case, it is not necessary to have the stoppers on a portion in addition to the external wall of the case. In addition, the height of the stoppers are set lower than the height of the bottom side of the operating lever so that only the projected portion on the operating lever can impact the stoppers. Also, each stopper is mounted at respective locations that are different distances from the center of the rotating axle, so that by just changing the position of the projected portions on the operating lever, the range of movement of the operating lever can be changed. In other words, the range of movement of the

operating lever can be changed without changing the case so that the case can be used in either situation.

Also, as described above, the present invention has a rotating torque bearing that makes up one side of the 5 rotating axle with projecting portions shaped in a toothed-wheel form, and an operating lever having gutters and a bonding hole into which the rotating torque bearing fits. The rotating axle and operating lever are ultrasonically bonded together at the rotating torque bearing so that, when the material of the rotating axle 10 is changed from metal to a resin material, the rotating torque bearing can increase the strength of the ultrasonically bonded portion and prevent the bonded portion from being broken by the rotating torque that the 15 operating lever receives. In addition, the width W_1 of one of the gutters is set narrower than the width W_2 of the other gutters, and a width W_3 of one of the projected portions of the rotating torque bearing is set narrower than the width W_4 of the corresponding other projected 20 portions. Therefore, the relative position of the movable plate and the operating lever during assembly is standardized to prevent incorrect assembly.

It will be appreciated that the present invention is not limited to the exact construction that has been 25 described above and illustrated in the accompanying drawings, and that various modifications and changes can be made. It is intended that the scope of the invention only be limited by the appended claims.

CLAIMS

1. An inhibitor switch device comprising:
 - a case (6) with a bearing hole (61);
 - a rotating axle (71) that fits into said bearing hole (61) so that said rotating axle rotates freely;
 - a movable plate (7) that moves freely in said case (6), said movable plate being integrated with said rotating axle (71);
 - a movable contact point (72) supported on said movable plate (7);
 - a fixed contact point (81) that corresponds with said movable contact point (72);
 - a platform (8) that supports said fixed contact point (81) and houses said movable plate (7) in conjunction with said case (6);
 - an operating lever (9) that is fixed to said rotating axle (71) and moves on an external surface (62) of said case (6); and
 - a rotating torque bearing (711) having projected portions (713, 714) in a toothed-wheel shape formed on said rotating axle (71), said operating lever (9) having slots (951, 952) and a bonding hole (95) into which said

rotating torque bearing (711) fits, and said rotating axle (71) and said operating lever (9) are bonded together by ultrasonic bonding at said torque bearing (711).

2. The inhibitor switch device according to claim 1, wherein a width W_1 of one of said slots (951) is set to be narrower than a width W_2 of another one of said slots (952), and a width W_3 of one of said projected portions (713) of the corresponding rotating torque bearing is set to be narrower than a width W_4 of another one of said projected portions (714).

3. The inhibitor switch device according to claim 2, wherein said widths W_1 , W_2 , W_3 and W_4 are set according to the relationship $W_3 \leq W_1 < W_4 \leq W_2$.

4. The inhibitor switch device according to claim 2, wherein each of said projected portions (713, 714) comprises a first narrow projected portion and a second wider projected portion, each of said slots (951, 952) comprises a first narrow slot portion and a second wider slot portion, said narrow projected portions being received in said narrow slot portions, and said wider projected portions being received in said wider slot portions, said widths (W_1 , W_2 , W_3 , W_4) being measured at said narrow projected portions and said narrow slot portions, respectively.

5. The inhibitor switch device according to claim 4, wherein an ultrasonic bond is formed between said rotating axle (71) and said operating lever (9) at a bonding spot (712) located between said narrow projected portions.



Application No: GB 0014036.8
Claims searched: 1 to 5

Examiner: Jason Clee
Date of search: 23 July 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H1N

Int Cl (Ed.7): B60R: 16/00

H01H: 21/02, 21/18, 21/22, 21/24, 21/28, 21/30, 21/34, 21/62, 21/64,
21/66, 21/68, 21/70, 21/72, 21/76 & 21/78

Other: None

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2300759 A (Fuji Jukogyo & Niles Parts)	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.